

WHAT IS CLAIMED IS

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1. A magnetic recording medium

comprising:

at least one exchange layer structure, and  
a magnetic layer formed on said exchange layer  
10 structure,

said exchange layer structure comprising:

a ferromagnetic layer; and

a non-magnetic coupling layer provided on  
said ferromagnetic layer and under said magnetic  
15 layer,

said ferromagnetic layer and said magnetic  
layer having antiparallel magnetizations.

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2. The magnetic recording medium as

claimed in claim 1, wherein said ferromagnetic layer  
is made of a material selected from a group  
25 consisting of Co, Ni, Fe, Ni-based alloys, Fe-based  
alloys, and Co-based alloys including CoCrTa, CoCrPt  
and CoCrPt-M, where M = B, Mo, Nb, Ta, W or alloys  
thereof.

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3. The magnetic recording medium as

claimed in claim 1, wherein said ferromagnetic layer  
35 has a thickness in a range of 2 to 10 nm.

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sub  
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sub A2

4. The magnetic recording medium as claimed in claim 1, wherein said ~~non-magnetic coupling layer is made of a material selected from a group of Ru, Rh, Ir, Ru-based alloys, Rh-based~~  
5 alloys, and Ir-based alloys.

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5. The magnetic recording medium as claimed in claim 1, wherein said non-magnetic coupling layer has a thickness in a range of 0.4 to 0.9 nm.

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6. The magnetic recording medium as claimed in claim 1, wherein ~~said magnetic layer is made of a material selected from a group of Co, and Co-based alloys including CoCrTa, CoCrPt and CoCrPt-M, where M = B, Mo, Nb, Ta, W or alloys thereof.~~

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7. The magnetic recording medium as claimed in claim 1, which further comprises:  
a substrate; and  
30 an underlayer provided above said substrate, said exchange layer structure being provided above said underlayer.

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~~8. The magnetic recording medium as~~

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claimed in claim 7, which further comprises:

a non-magnetic intermediate layer interposed between said underlayer and said exchange layer structure,

5 said non-magnetic intermediate layer having a hcp structure alloy selected from a group of CoCr-M, where M = B, Mo, Nb, Ta, W or alloys thereof, and having a thickness in a range of 1 to 5 nm.

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9. The magnetic recording medium as claimed in claim 8, which further comprises:

15 a NiP layer interposed between said substrate and said underlayer, said NiP layer being mechanically textured or oxidized.

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Sub AS 10. The magnetic recording medium as claimed in claim 7, wherein said underlayer is made of a B2 structure alloy selected from a group of  
25 NiAl and FeAl.

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11. The magnetic recording medium as claimed in claim 1, which comprises at least a first exchange layer structure and a second exchange layer structure interposed between said first exchange layer structure and said magnetic layer, wherein a  
35 ferromagnetic layer of said second exchange layer structure has a magnetic anisotropy lower than that of a ferromagnetic layer of said first exchange

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layer structure, and magnetizations of the ferromagnetic layers of said first and second exchange layer structures are antiparallel.

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12. The magnetic recording medium as claimed in claim 1, which comprises at least a first exchange layer structure and a second exchange layer structure interposed between said first exchange layer structure and said magnetic layer, wherein a product of a remanent magnetization and thickness of a ferromagnetic layer of said second exchange layer structure is smaller than that of a ferromagnetic layer of said first exchange layer structure, and magnetizations of the ferromagnetic layers of said first and second exchange layer structures are antiparallel.

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13. A magnetic storage apparatus comprising:  
at least one magnetic recording medium including at least one exchange layer structure, and a magnetic layer formed on said exchange layer structure; and  
at least one head recording information on and/or reproducing information from the recording medium,  
said exchange layer structure comprising:  
a ferromagnetic layer; and  
a non-magnetic coupling layer provided on said ferromagnetic layer and under said magnetic layer,

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said ferromagnetic layer and said magnetic layer having antiparallel magnetizations.

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14. The magnetic storage apparatus as claimed in claim 13, wherein said ferromagnetic layer is made of a material selected from a group consisting of Co, Ni, Fe, Ni-based alloys, Fe-based alloys, and Co-based alloys including CoCrTa, CoCrPt and CoCrPt-M, where M = B, Mo, Nb, Ta, W or alloys thereof.

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15. The magnetic storage apparatus as claimed in claim 13, wherein said ferromagnetic layer has a thickness in a range of 2 to 10 nm.

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16. The magnetic storage apparatus as claimed in claim 13, wherein said non-magnetic coupling layer is made of a material selected from a group of Ru, Rh, Ir, Ru-based alloys, Rh-based alloys, and Ir-based alloys.

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17. The magnetic storage apparatus as claimed in claim 13, wherein said non-magnetic coupling layer has a thickness in a range of 0.4 to 0.9 nm.

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18. The magnetic storage apparatus as claimed in claim 13, wherein ~~said magnetic layer is made of a material selected from a group of Co, and Co-based alloys including CoCrTa, CoCrPt and CoCrPt-~~  
5 M, where M = B, Mo, Nb, Ta, W or alloys thereof.

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